

Algorithm Development for a Coherent Fiber Lidar as a Wake Vortex Monitoring Sensor, Phase I

Completed Technology Project (2013 - 2013)



Project Introduction

The capacity of coherent Lidar systems to produce a continuous, real-time, 3D scan of wind velocities via detection of backscatter of atmospheric aerosols in clear-air conditions gives this technology a clear advantage over other technologies. LIDAR has proven its value in a number of applications, including the detection of clear-air turbulence, wind shear, and aircraft wake vortices. Of interest under this NASA sub-topic is the development of Lidar systems capable of detecting and measuring aircraft wake vortices in order to enhance aircraft separation criteria. To perform this task well a Lidar must have certain characteristics and be paired with a highly optimized wake processing algorithm. Key areas of development include: - Pulse energy / pulse repetition frequency (PRF) combination to adequately sample a region of space containing the wake vortices. - Pulse width for optimally sampling the wake disturbance. Determination of the optimal range resolution for measuring wakes is algorithm dependent and is an area of current research. - Scanner capable of efficiently scanning the region of interest. The scanner needs to be able to report the elevation and azimuth accurately so that wake positions can be estimated. - Raw data acquisition and signal processing for generating range resolved Doppler spectral estimates. Processing should produce periodograms over the 2D or 3D region of interest with adequate frequency resolution, velocity bandwidth and with minimal distortion. - Wake vortex algorithm for detecting, tracking and estimating the circulation strength and position of the vortices from the Doppler spectral estimates. SIBELLOPTICS proposes a Phase 1 SBIR to determine the feasibility of its compact, innovative fiber LIDAR sensor, now in Phase II development, to detect and measure wake vortices using spatially dependent spectral matched filter algorithms similar to those currently being developed for NASA by Coherent Research Group.

NASA SBIR/STTR Technologies
 Algorithm Development for a Coherent Fiber Lidar as a Wake Vortex Monitoring Sensor
 SIBELLOPTICS, LLC
 Boulder, CO
 Proposal No.: E2.91-18B73

Identification and Significance of Innovation
 In order to detect and measure wake vortices for the purpose of improving aircraft separation criteria a Lidar with the appropriate design parameters must be coupled with a highly optimized wake processing algorithm. Sibeloptics Windmiller will be paired with Coherent Research Group's wake vortex algorithms to produce a sensor ideally designed for wake vortex detection.
 Estimated TRL at beginning: TRL 2
 Estimated TRL at end of contract: TRL 3

Technical Objective:
 The program objective is to produce a compact, efficient, next generation coherent LIDAR sensor capable of measuring aircraft-induced wake vortices. In addition, the LIDAR system will offer pronounced user flexibility and a state-of-the-art, intuitive data display.
Task Plan:
 1. Management & Reporting: 178 hours
 2. System Performance Modeling & Initial Assessment as a Wake Sensor: 20 hours
 3. Windmiller Signal Processing Algorithm Development: 204 hours
 4. Raw Data Collection & Processing: 224 hours
 5. Analysis of Raw Data & Processed Raw Data Products: 120 hours
 6. Define Requirements for Phase 2: 380 hours

NASA and Non-NASA Applications
 NASA: Wake Vortex detection and measurement for improved aircraft separation criteria.
 Commercial:
 1. Aviation
 2. Renewable Wind Energy
 3. Yacht Instrument & Harbor Subscriptions
 4. Meteorological Applications
 5. Homeland Security
 6. Freightlifting
Point Contact:
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 Phone: 303.913.1172 email: ranscher@msn.com

NON-PROPRIETARY DATA

Algorithm Development for a Coherent Fiber Lidar as a Wake Vortex Monitoring Sensor

Table of Contents

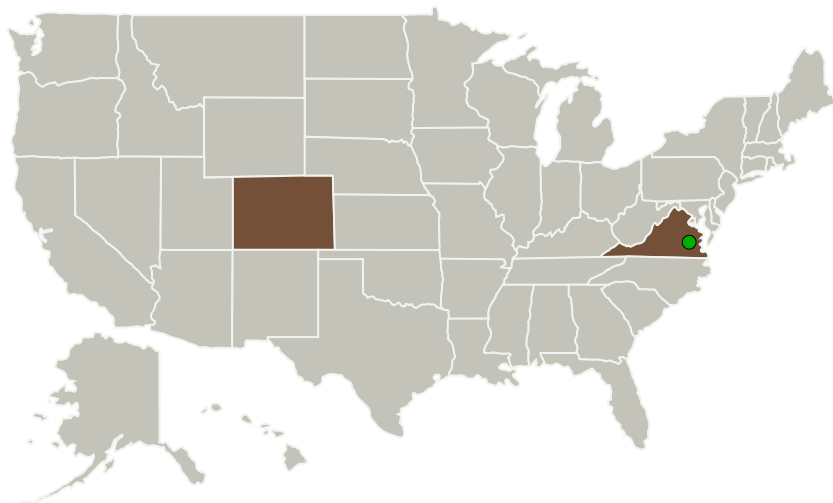
Project Introduction	1
Primary U.S. Work Locations and Key Partners	2
Project Transitions	2
Organizational Responsibility	2
Project Management	2
Technology Maturity (TRL)	2
Images	3
Technology Areas	3
Target Destinations	3

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Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Sibelloptics	Lead Organization	Industry	Lafayette, Colorado
● Langley Research Center(LaRC)	Supporting Organization	NASA Center	Hampton, Virginia

Primary U.S. Work Locations

Colorado	Virginia
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Project Transitions

**May 2013:** Project Start**November 2013:** Closed out

Closeout Documentation:

- Final Summary Chart(<https://techport.nasa.gov/file/137988>)

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Sibelloptics

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

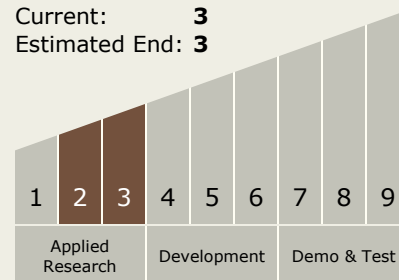
Carlos Torrez

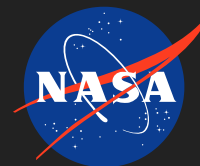
Principal Investigator:

Richard L Higgins

Technology Maturity (TRL)

Start: 2
Current: 3
Estimated End: 3





Images



Project Image

Algorithm Development for a
Coherent Fiber Lidar as a Wake
Vortex Monitoring Sensor
(<https://techport.nasa.gov/image/130316>)

Technology Areas

Primary:

- TX08 Sensors and Instruments
 - └ TX08.1 Remote Sensing Instruments/Sensors
 - └ TX08.1.5 Lasers

Target Destinations

The Moon, Mars, Outside the Solar System, The Sun, Earth, Others Inside the Solar System